



THE IMPACT OF NOISE LEVELS IN HEALTHCARE FACILITIES ON NERVOUS SYSTEM FUNCTION AND WORK PERFORMANCE

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Abstract

Excessive noise levels in healthcare facilities that exceed hygienic standards have a significant negative impact not only on patients but also on the functioning of the nervous system and work performance of medical personnel. Recent scientific studies indicate that noise, as a stress factor, disrupts the activity of the central nervous system, reduces cognitive functions, and decreases work efficiency. The aim of this literature review is to systematically analyze the effects of noise in healthcare settings on the nervous system and occupational performance based on contemporary scientific evidence. Noise levels in intensive care units have frequently been reported to reach 70–85 dB. In addition, noise exposure has been associated with sleep disturbances, autonomic nervous system imbalance, and chronic fatigue syndrome.

Keywords: Noise, hygiene, nervous system, work performance, stress, intensive care unit, cognitive functions, acoustic pollution.

Introduction

The quality of the acoustic environment in healthcare facilities is an important issue in modern medical hygiene and occupational physiology. Although noise is often considered a secondary environmental factor, recent scientific evidence confirms that it significantly affects not only patients but also the neuropsychological state, attention stability, cognitive functions, and work productivity of healthcare workers. The World Health Organization (WHO) defines noise as an underestimated health risk factor with widespread adverse consequences, including sleep disturbances, cardiovascular effects, impaired cognitive performance, and reduced work efficiency. Furthermore, WHO identifies noise as a distinct occupational hazard for healthcare workers.



The problem of noise in healthcare facilities is particularly relevant due to the multi-source and continuous nature of acoustic exposure in such environments. Noise sources include monitor and infusion pump alarms, ventilation systems, emergency alerts, medical equipment, staff communication, transportation activity, and patient flow, all of which contribute to the overall background noise.

According to WHO guidelines, the average noise level in treatment and observation rooms should not exceed 35 dB(A) during the day, while nighttime levels in patient wards should remain below 30 dB(A), with maximum nighttime levels around 40 dB(A). However, systematic reviews and measurements conducted in hospital wards, intensive care units, and emergency departments demonstrate that these standards are frequently exceeded in practice.

The impact of noise on the nervous system is mediated through complex pathophysiological mechanisms. Continuous or repeated acoustic stimulation increases central nervous system arousal, activates the sympathetic-adrenal system, enhances stress-response reactions, and leads to the accumulation of psycho-emotional strain.

As a result, fatigue, irritability, impaired attention, poor sleep quality, decreased reaction speed, and reduced accuracy in decision-making are observed. According to WHO data, excessive noise is associated with cognitive impairment and negative mental health outcomes, while occupational noise exposure is linked to sleep disturbances and deterioration in overall health status.

Healthcare work is characterized by high cognitive load, rapid clinical decision-making, low tolerance for errors, and the need for continuous communication. It has been demonstrated that increased noise levels in operating rooms, intensive care units, and emergency care settings are associated with higher workload, elevated stress, and an increased likelihood of errors.

A systematic review conducted among operating room staff reported that noise negatively affects both stress levels and work performance within the team. Similarly, an applied study conducted in 2021 found that noise in the operating room was associated with increased workload and elevated stress indicators. Studies carried out in emergency departments have shown that higher noise levels correlate with impaired attention, worsened stress markers, and even with professional burnout and intentions to leave the job.



The impact of noise on work performance is not limited to subjective discomfort. Scientific evidence indicates that high acoustic load reduces attentional resources, increases mental workload, and impairs both visual and auditory attention. Experimental and observational studies have demonstrated that under noisy conditions, cognitive performance, response accuracy, and task execution quality deteriorate. This is of particular importance in healthcare settings, where any decline in cognitive functioning may increase the risk of diagnostic, therapeutic, and organizational errors.

Another critical aspect of the problem is the long-term occupational consequences of noise exposure. Healthcare workers are typically not exposed to extremely high noise levels as in industrial settings; however, they are subjected to chronic moderate and highly variable acoustic loads. Such exposure has been associated with hearing impairment, tinnitus, sleep disturbances, and psychological strain. A longitudinal study conducted among hospital staff reported that in the high-noise group, the average exposure level was 70.4 ± 4.5 dBA, with a higher risk of hearing loss observed. These findings suggest that noise should be considered not merely as an issue of acoustic comfort but as an occupational health concern.

Despite this, several methodological limitations remain in the existing literature. First, studies have been conducted across different hospital units—operating rooms, intensive care units, emergency departments, sterilization centers, and general wards—where noise sources and acoustic profiles differ substantially. Second, nervous system activity is assessed using diverse indicators, including stress scales, heart rate, Stroop test performance, sleep quality, emotional status, and burnout measures. Third, the concept of “work performance” is not uniformly defined; some studies measure it through error rates, while others assess attention, reaction time, and subjective workload.

Therefore, a comprehensive, standardized, and hygiene-oriented analysis of the neurophysiological and performance-related effects of noise in healthcare settings remains an arduous scientific task.

The relevance of this topic lies in the fact that creating a safe acoustic environment in healthcare facilities simultaneously contributes to two strategic outcomes: first, it reduces nervous system strain among staff and preserves work capacity; second, it improves the quality of clinical decision-making and enhances patient safety. Consequently, studying the impact of noise levels on nervous system function and



work performance represents an important interdisciplinary research direction at the intersection of hygiene, occupational physiology, occupational diseases, and healthcare management.

Aim of the Study

To systematically analyze, based on scientific literature, the impact of noise levels in healthcare facilities on nervous system function and work performance.

Materials and Methods

This literature review was conducted based on scientific articles published in the PubMed, Scopus, ScienceDirect, and World Health Organization databases.

Selected sources: Articles published between 2005 and 2024; Randomized controlled trials (RCTs), cohort studies, and systematic reviews; Studies evaluating noise levels and their physiological or psychological effects

Methods of analysis: Descriptive analysis, Comparative analysis, Integration of statistical data

Results

The findings of contemporary scientific studies on the impact of noise levels in healthcare facilities on nervous system function and work performance indicate that acoustic load represents a significant pathophysiological and functional factor affecting both healthcare workers and patients.

The analyzed literature evaluates the effects of noise across several key domains: acoustic level (dB), cognitive functions, stress and neurophysiological responses, work performance, and clinical safety indicators.

Noise Levels (dB) in Healthcare Facilities and Deviation from Standards. Numerous studies demonstrate that actual noise levels in hospitals significantly exceed the recommendations of the World Health Organization (WHO).

Table 1. Noise Levels in Hospitals (Based on Scientific Studies)

Study	Department	Average Noise (dB)	Maximum (dB)	Compared to WHO Standard
<i>Darbyshire et al., 2013</i>	ICU	52–59 dB	>85 dB	↑ 40–70% higher
<i>Nyembwe et al., 2023</i>	ICU	68–82 dB	94 dB	↑ 2 times higher
<i>Filipović et al., 2025</i>	ICU	80–90 dB	—	Extremely high
<i>Adams et al., 2024</i>	Emergency	55 dB	117 dB	↑ 2–3 times higher

These results indicate that intensive care units and emergency departments are characterized by the highest acoustic load, with noise levels frequently ranging between 70–90 dB, whereas WHO guidelines recommend that this level should not exceed 35 dB.

Impact on Nervous System Function (Cognitive and Neurophysiological Changes). Experimental and clinical studies demonstrate that noise directly affects central nervous system activity.

Table 2. Effects of Noise on Cognitive Functions

Study	Noise Level	Outcome
Jafari et al., 2019	95 dB	Decreased attention and memory
Erne et al., 2022	ICU conditions	Work performance ↓ 27%
Li et al., 2025	Operating room	Increased stress and reduced attention

Under noise exposure: Attention and selective focus decrease; Mental workload increases; Brain activity shifts (increased alpha waves, decreased beta waves); Decision-making speed declines. Furthermore, working under noisy clinical conditions increases the likelihood of medical errors and impairs short-term memory. *Stress, Psychoemotional Strain, and Alarm Fatigue.* Noise acts as a strong stressor, activating the sympathetic nervous system.

Table 3. Psychoemotional Effects of Noise

No.	Indicator	Outcome
1	Stress level	↑ significantly increases
2	Heart rate	↑ increases
3	Alarm fatigue (nurses)	47% high prevalence
4	Burnout risk	↑ increases

Studies conducted among ICU nurses report that the prevalence of “alarm fatigue” reaches approximately 47%.

Noise exposure: increases stress and anxiety, disrupts attention, accelerates mental fatigue, interferes with workflow processes. Quyida matningiz akademik ingliz tiliga tarjima qilindi, jadvallar to‘liq strukturasi bilan saqlandi:

Work Performance and Association with Errors. One of the most significant clinical consequences of noise exposure is the decline in work performance.

Table 4. Effect of Noise on Work Performance

No.	Indicator	Outcome
1	Cognitive performance	↓ decreases
2	Clinical errors	↑ increases
3	Communication quality	↓ deteriorates
4	Reaction time	↓ slows down

Studies demonstrate that noise reduces work productivity and increases communication errors, which directly affects patient safety. In intensive care unit (ICU) settings, noise has been identified as the “most disturbing stressor.”

Physiological and Clinical Consequences. The effects of noise are not limited to psychological outcomes but also include physiological changes.

Table 5. Clinical Effects of Noise

No.	Indicator	Effect
1	Sleep quality	↓ impaired
2	Risk of delirium	↑ increased
3	Blood pressure	↑ elevated
4	Heart rate	↑ increased

High noise levels are associated with sleep disturbances, the development of delirium, and cardiovascular responses.

Discussion

The findings of this literature review confirm that noise levels in healthcare facilities exert a significant and multifaceted impact on nervous system function and work performance. The obtained data indicate that noise is not merely a background factor



but a critical hygienic determinant that modulates the neurophysiological state, cognitive resources, and clinical performance of healthcare professionals.

First, nearly all analyzed studies report that noise levels exceed the standards recommended by the World Health Organization (WHO) by 2–3 times. This indicates the presence of “acoustic overload” in hospital environments. Particularly in intensive care units and emergency departments, noise levels ranging from 70 to 90 dB can be considered a persistent physiological stressor. Under such conditions, the central nervous system remains in a constant state of activation, leading to chronic stimulation of the sympathetic-adrenal system.

Second, the results related to cognitive functions clearly demonstrate the direct impact of noise on the nervous system. Decreases in attention, short-term memory, and selective focus indicate that noise disrupts information processing at the level of the central nervous system. From a classical neurophysiological perspective, this can be explained by the phenomena of “sensory overload” and “cognitive interference.” In noisy environments, a portion of brain resources is allocated to filtering external acoustic stimuli, thereby reducing the cognitive resources available for primary clinical tasks. This is particularly critical in medical practice, where high accuracy and rapid decision-making are required.

Third, findings related to psychoemotional strain and stress responses confirm the role of noise as a chronic stressor. Increased heart rate, elevated cortisol secretion, and higher subjective stress levels have been observed under noise exposure. Over time, these changes may lead to professional burnout, emotional exhaustion, and reduced job satisfaction.

In particular, the phenomenon of “alarm fatigue” represents a specific challenge in healthcare settings. Continuous exposure to alarms and warning signals leads to desensitization, increasing the risk of misinterpreting or ignoring clinically important alerts. This, in turn, constitutes a direct threat to patient safety.

Fourth, the findings related to work performance reveal the practical clinical consequences of noise exposure. Studies indicate that under high-noise conditions:

- the number of clinical errors increases,
- the quality of communication deteriorates,
- reaction time slows down,
- the quality of performing complex tasks declines.



These findings can be interpreted from the perspective of the “human factor” theory. External stressors, including noise, increase cognitive workload in the working environment, thereby limiting human functional capacity and increasing the probability of errors. In the medical field, such errors may lead to serious clinical consequences.

Fifth, physiological and clinical indicators demonstrate the systemic impact of noise. Sleep disturbances, increased arterial blood pressure, cardiovascular responses, and a higher risk of delirium indicate that noise is an important risk factor not only for healthcare workers but also for patients. In particular, in intensive care units, sleep fragmentation and acoustic stress may negatively affect patients’ recovery processes. At the same time, several methodological limitations are evident in the analyzed literature. First, studies have been conducted across different hospital departments, where noise sources and intensity vary considerably. Second, nervous system activity is assessed using diverse methods (subjective questionnaires, physiological indicators, cognitive tests), complicating direct comparison of results. Third, the concept of “work performance” is interpreted differently across studies, requiring caution when drawing generalized conclusions.

Another important aspect is individual susceptibility. The effects of noise are not uniform across all healthcare workers; factors such as age, work experience, psychological resilience, and level of adaptation play a significant role. Therefore, future research should incorporate an individualized, differential approach.

Conclusion

The results of this literature review provide strong scientific evidence that noise levels in healthcare facilities have a significant negative impact on nervous system function and work performance. Noise represents a multifactorial hygienic determinant that directly affects the efficiency of the healthcare system by impairing cognitive functions, increasing psychoemotional strain, and reducing the quality of clinical performance.

1. Noise levels in healthcare facilities often exceed hygienic standards by 2–3 times, acting as a significant environmental factor that induces chronic stress responses in the central nervous system.



2. Noise exposure leads to decreased attention, memory, and decision-making speed, resulting in impaired cognitive functions and negatively affecting professional performance among healthcare workers.
3. Noise increases psychoemotional strain, contributing to stress, fatigue, and the development of occupational burnout, particularly through the phenomenon of “alarm fatigue,” which poses a threat to clinical safety.
4. Work performance and the quality of clinical activity decline under noisy conditions: communication is impaired, error rates increase, and reaction time decreases, all of which constitute significant risks to patient safety.
5. Noise is a modifiable hygienic factor; its optimization can improve the functional state of healthcare workers, enhance work performance, and improve the quality of medical care.

Optimizing the acoustic environment in healthcare facilities is not only a hygienic requirement in modern medicine but also a strategic priority aimed at improving clinical effectiveness and ensuring patient safety.

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